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XX.—*On an Anomaly among the Hydromedusæ, and on their Mode of Nutrition by Means of the Ectoderm.* By C. Mereschkowsky.

[Plate XX.]

In one of my former articles on the Hydroids * I mentioned, among other things, a new species of small Medusa belonging to the genus *Bougainvillea*, which I named *Bougainvillea paradoxa*, but without giving any description of it. A very short description of it has been given in Russian in the Transactions of the Society of Naturalists of St. Petersburg †.

Here I shall only speak very briefly of the normal Medusa itself, as it is my intention to make another journey to the White Sea, and to make a more detailed investigation of this interesting organism than I have hitherto been able to do. In the present note I shall refer especially to a strange anomaly which may be pretty frequently observed among the normal individuals of *Bougainvillea paradoxa*, and to its physiological consequences.

The adult Medusa does not much exceed 1 centim. in length. Its form (Pl. XX. figs. 1 and 5) is that of a bell slightly contracted at its aperture; there are four radiating canals, each furnished at its extremity with a tuft of from three

* "Studies on the Hydroida," Ann. & Mag. Nat. Hist. ser. 5, vol. i. April 1878, p. 323.

† Protocolles de la Réunion du 14 Janvier 1878, in vol. ix. p. 33.

to seven tentacles and with a red ocellus. The manubrium, which is deep red, has, when looked at from above, the form of a cross (fig. 2, *a*), from each of the four ends of which starts a radiating canal (fig. 2, *b*). Round the mouth there is a circle of four tentacles dividing dichotomously into a great number of branches. The most remarkable thing about this Medusa is that the ova are developed immediately on the surface of the manubrium; so that the latter, when the ova have become converted into planulæ, acquires a tuberculate aspect, caused by a great quantity of planulæ, forming a layer covering its surface, with one of their ends projecting freely, and the other attached to the wall of the manubrium.

Among the innumerable individuals of this Medusa one occasionally meets with some which, at the first glance, attract the attention of the observer by the complete absence of the coloured manubrium. These are scarcely perceptible, in consequence of their perfect transparency, while ordinarily it is easy to follow their movements by the dark red colour of the manubrium. I thought at first that I had to do with a perfectly different species of Medusa; but on examining it more minutely under the microscope I convinced myself that I really had before me *Bougainvillea paradoxa*.

In fact the form of the bell (Pl. XX. fig. 3), the four radial canals, the four bundles of tentacles, and the four red ocelli are all identical with those of the Medusa that I have just described; but what I ascertained, to my great surprise, was the total absence of the manubrium. I thought at first that there might be a more or less complete atrophy of this organ; and I sought for some remains of it, but in vain. On the contrary, I convinced myself that the individuals in question were completely destitute of manubrium, and that the whole gastrovascular system consisted only of a circular canal and of the four radial canals, which were united at the summit without forming any thing resembling a stomach (figs. 3 and 4).

Moreover I ascertained beyond all doubt that all this gastrovascular system, which was in other respects of normal conformation, had absolutely no opening to the exterior, no buccal or other aperture which might establish a communication between this system and the circumambient water. On placing the Medusa in such a position that I could examine it in the direction of its principal axis, it presented me with the appearance represented in fig. 4. The four canals were seen to unite in the centre without forming any enlargement or cavity even of the most insignificant kind. Under a high power the entodermic cells of the canals and their long cilia in

movement could be easily distinguished; and I should infallibly have remarked an aperture if there had been one.

It is therefore an undoubted fact that among the individuals of *Bougainvillea paradoxa* there are some which have no buccal aperture, no communication between the exterior water and the gastrovascular system of the Medusa—a fact which appears to me very curious, and furnishing no explanation how the nutrition and growth of the organism can be effected. The fact is the stranger because these anomalies are observed, and indeed most frequently, in Medusæ which are but very little exceeded in size by the normal adult individuals. They must consequently have been able to grow and to nourish themselves, since from microscopic embryos they have attained a size of more than half a centimetre.

Besides *Bougainvillea paradoxa* we find in the White Sea another Medusa belonging to the same genus, but distinguished from the former by the general form of the body (Pl. XX. fig. 6), which is more elegant, with a little cupola placed on the summit of the bell, and further by the possession of eight instead of four black ocelli, by the presence of three tentacles (never more) in each of the four groups, and, lastly, by the very short and sparingly ramified buccal tentacles. This Medusa occurs less frequently than the other; and it is also of rather smaller size.

As in the former species, although less frequently, I have met with individuals which differed from the normal type in having nothing coloured about them except the eight black ocelli, and no red coloration in the centre—that is to say, where the coloured manubrium ought to be situated. The cause was the same, namely the total deficiency of the manubrium (Pl. XX. fig. 7) and of the buccal orifice. As may be seen from the figure, the four radial canals unite without forming a stomachal cavity; and by examining the animal under the microscope the complete absence of any orifice, aperture, or pore by which the sea-water with its nutritive contents might penetrate into the canals is easily ascertained.

It may therefore be proved that, at least in two different species, the Medusa may live, increase in size, and develop itself without having any need of digestive organs, and even, apparently, without nourishment, since the latter cannot penetrate into the gastrovascular system. One cannot help asking how all these functions can be performed, how the Medusa can grow and become a complete Medusa from an almost imperceptible embryo, without the aid of organs of nutrition and without food. The supposition that all this can take place without nourishment is absurd and cannot be accepted; it is

absolutely necessary that the Medusa should be nourished in some way or another to be able to grow; it remains therefore to discover the means by which the nutrition of the normal animals is replaced in the case of the anomalies in question. After searching through all the possible means, I can only rest upon a hypothesis which seems to me the only probable one. We are led by the facts to admit that *the Medusa can nourish itself by means of its ectoderm by absorbing the organic material dissolved in the sea-water.*

This supposition is the more probable since, as I have demonstrated in the case of the sponges*, these, in certain cases, also nourish themselves upon organic matter dissolved in sea-water, and also by means of their ectoderm. The comparatively large number of anomalies of this kind that I have been able to observe prove that it is by no means an impossible thing, or even very difficult, for a Medusa to dispense with its entoderm in order to live and attain nearly its normal size, just as is the case in certain sponges. We must therefore conclude that, in certain cases at least†, the ectoderm may fulfil the function of the entoderm; that is to say, it may, as well as the latter, extract and assimilate the organic matter dissolved in water ‡. That we have really to do with organic matters dissolved in the water, and that it is not in the form of solid particles that the nourishment is absorbed, cannot be doubted; for the examination of the surface of the Medusa proves that it never contains any such particles. We should thus have two cases of such nutrition almost completely proved—in the class of Sponges, and in that of the Hydromedusæ. What has just been stated may be summarized as follows :—

1. Two species of Medusæ (of the genus *Bougainvillea*) present pretty commonly an anomaly which consists in the complete absence of the manubrium and buccal orifice, and which thus presents no communication of the gastrovascular system with the circumambient water.

* C. Mereschkowsky, "Études sur les Éponges de la Mer Blanche," Mém. Acad. Sci. St. Pétersb. tome xxvi. no. 7 (1878), pp. 12, 13.

† I say "at least," because it is more than probable that in the normal condition the ectoderm also assists in nutrition. There is no reason to endow the ectoderm with this faculty in one case, and to deprive it of it in another. It is probable that, in the two classes of the Sponges and the Hydromedusæ, the two layers are not yet entirely differentiated, although the experiments of Trembley with *Hydra* and the conversion of its entoderm into ectoderm have not been confirmed by the recent experiments of M. Engelmann (see 'Zoologischer Anzeiger,' 1878, no. 4).

‡ It is probably for this reason that we so often meet with this anomaly, that the Medusa can do without the entoderm, and yet nourish itself and grow.

2. As nutrition cannot take place by means of organs of digestion (*i. e.* of the entoderm) it must be effected by the ectoderm, by the absorption of the organic materials dissolved in sea-water.

St. Petersburg, Dec. 10, 1878.

EXPLANATION OF PLATE XX.

Fig. 1. *Bougainvillea paradoxa*, Mer., normal form, enlarged.
Fig. 2. The same, from above: *a*, manubrium; *b*, radial canal.
Fig. 3. An abnormal individual, destitute of stomach and of buccal aperture.
Fig. 4. The same, from above.
Fig. 5. A normal Medusa of the natural size.
Fig. 6. Another species, normal individual, rather more enlarged than figs. 1–4.
Fig. 7. The same, abnormal individual, without manubrium and buccal orifice.

XXI.—*On the Structure of* Amphibola avellana. By F. W. Hutton, F.G.S., Professor of Natural History in the University of Otago, New Zealand.

[Plate XXII.]

MM. Quoy and Gaimard were the first to study the anatomy of *Amphibola avellana*; and their researches were published in the 'Zoology of the Voyage of the Astrolabe' (vol. ii. p. 196, pl. xv. figs. 1–8). They ascertained that it was a true pulmonate, with the pulmonary cavity closed in front, and that it was hermaphrodite. So far as I know, this is the only description published of the anatomy of any member of the genus; and as their account is inaccurate in several points, the following results of an examination I have lately made of the same species will not be without interest.

The animal lives between tide-marks in salt or brackish water, on mud flats in sheltered bays. When found at all, it is always found in large quantities. It is very sluggish in its habits, and feeds on the vegetable matter contained in the mud, passing large quantities through its alimentary canal. Although air-breathing, it will live for a week or ten days in fresh water, and for more than a fortnight in salt water without being exposed to the air.

I have nothing to add to the description of its general form given by MM. Quoy and Gaimard, except to point out that they overlooked the two small, flattened, triangular tentacles just in front of the eyes (fig. 1, *c*). These tentacles can be